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Artificial Opening of Pulmonary Cavities, Insertion of Rubber Tube and Injection of Chlorine Gas.

Read before the Section of Surgery and Anatomy at the Forty-fourth Annual Meeting of the American Medical Association.

BY E. L. SHURLY, M.D.
DETROIT, MICH.

Reprinted from "The Journal of the American Medical Association,"
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ARTIFICIAL OPENING OF PULMONARY CAVITIES,
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Mr. President and Gentlemen:—Being a physician, I owe this assembly of surgeons an apology for appearing with a surgical paper. For I know full well that physicians, as a rule, are as incompetent in the practice of surgery as most surgeons are in the practice of medicine. Therefore it is with some hesitation that I venture to submit the following observations and remarks:

The surgery of the thoracic cavity, excepting for the opening of the pleural sac has been heretofore rather forbidden ground, because, as we know, fraught with so many imminent dangers to life. The possibility however, of doing something in a surgical way toward the mitigation or arrest of the course of disease in cases of pulmonary abscess, either benign or tuberculous has occurred to many during years past. As long ago as 1844 a large apex cavity was incised and a drainage tube inserted by Drs. Hastings and Stork. In 1873 Mossler tapped pulmonary cavities and injected iodized and other antiseptic solutions, and from time to time after this, Cayley, Godlee and others tapped such pulmonary cavities and injected iodized and other antiseptic fluids; again in 1879 Mr. Douglass Powell at Middlesex hospital in London, opened up pulmonary cavities and inserted a drainage tube. Since then such efforts have been made at long intervals but with indifferent results only. In later years attempts have been made to excise diseased portions of the lung but

always with fatal effect I believe. This latter practice originated from the encouraging results obtained from several experiments made upon the lower animals, in which the thoracic cavity was opened freely, portions of the lung first ligated, and then excised, without producing the immediate death of the animal. It has been observed that nature once in awhile brings about a discharge externally of the contents of pulmonary cavities through the process of ulceration to the surface.

A notable case of this kind was recorded in 1843 in the London *Lancet*, occurring in a man who lived a number of years afterwards. Other cases of the sort have been reported from time to time, and similar results have been recorded in cases of pulmonary abscess in connection with pyopneumo-thorax and empyema.

For this reason it has for a long time been my conviction that we would be justified in applying our art in imitation of nature in order to bring about such results. However, the difficulties besetting the undertaking are not to be treated lightly; of which I will mention first the difficulty of determining with certainty the location of cavities, and the distinguishing of pulmonary excavations from locular collections in the pleura cavity, or of distinguishing bronchitetic cavities from others. I believe it well nigh impossible with certainty to determine the perspective, so to speak, of a pulmonary cavity; that is, whether it be a half inch, or two or three inches from the surface with or without much intervening pulmonary parenchyma. And it will readily be seen that this is an important point, inasmuch as the cutting through pulmonary tissue in getting to a cavity, opens up two sources of danger; one from hemorrhage, and the other from infection by the contents of the cavity coming in contact with freshly incised surfaces of lung tissue, upon which are exposed open lymph vessels or spaces.

The immediate dangers from hemorrhage, shock and

consequent septicemia are not to be overlooked in undertaking such operations, notwithstanding the protective influence afforded by the modern methods of aseptic surgery. Besides these we must not forget the consecutive accidents to the nervous system such as convulsions, chorea, paralysis, meningitis, etc., which frequently follow operations on the chest, according to Auboin, Cayley, Weil, M. Roupert and others. At the Congress on Tuberculosis of 1891, held in Paris, Paul Poirier and Jonnesco presented a valuable paper on the treatment of pulmonary cavities at the apex of the lung, by incision, drainage, and subsequent disinfection with antiseptic fluids. In this paper they reported twenty-nine cases of such operations having been made which resulted in the amelioration of the condition in fifteen cases, cure in four, immediate death in nine and one result not stated. Their method of procedure consisted in making free incisions, by preference at the second intercostal space (without resection of the rib) down to the pleura, and thence entering the cavity with the thermo-cautery knife. In the cases which I shall briefly present for your attention their method of operation was pretty closely adopted. Although the signal failure of these operations as hitherto recorded, would lead one to hesitate upon the adoption of such means, it occurs to me that the two great causes of failure may be traced to the use of the knife instead of the galvano-cautery or thermo-cautery for making the opening through the pleura and lung, and to the injection of fluids; while a third might be added, consisting of the opening into a free pleural cavity.

Dr. Gibbes and myself have demonstrated to our own satisfaction that chlorine gas is capable of entirely destroying the virulence of tubercle or caseous material whenever the same has been properly exposed to it. Therefore it occurred to me that this agent would be the most desirable one for introduction into a pulmonary cavity providing it could be

tolerated; not only for its immediate local effect, but also because of its gaseous nature fitting it to reach not only all of the adjacent diseased parts, but possibly the remote parts of the lung, thus providing a complete plan of local aseptic medication. The question, therefore, would seem to hinge upon some practical method of its introduction. We know by experience that it requires persistent effort on the part of the patient to inhale a sufficient quantity by the natural way to even secure a limited action upon the caseous surfaces exposed to the inspiratory current, and that its introduction is resisted by the glottis. I therefore felt justified in testing its adaptability in this way as soon as opportunity offered. The method pursued in the cases that I shall briefly report was as follows:

After anæsthetization by chloroform, an incision with a bistoury was made parallel with the ribs at the second intercostal space from near the margin of the sternum for about two and a half inches carefully avoiding the internal mammary and intercostal arteries; then the muscles were divided by as little incision as possible down to the costal pleura. Having reached the surface of this membrane the bistoury was exchanged for the incandescent galvano-cautery knife with which the pleura and intervening lung tissue was divided, until the cavity was reached. Into the opening a drainage tube (which was previously flanged) and secured to a piece of lead plate or zinc was inserted, the tube being long enough to extend some distance above the surface. The end of this tube was afterwards closed with a plug of absorbent cotton, which was of course removed whenever the cavity was treated. The diluted chlorine gas was obtained by pumping air with a common rubber bulb through a Wolff bottle which had been previously half filled with freshly made chlorine water, and connected by a piece of glass tubing with the tube in the thorax. The air in passing through this becomes strongly impreg-

nated with the gas; and twelve to fifteen bulbs-full can be introduced at a time, and repeated every two to four hours. Contrary to expectation this procedure produced very little uneasiness, and little or no cough. In fact its effect was quite comforting to the patient.

The first case in which chlorine¹ was tried, was a sailor, age 32, who was brought to Harper hospital Oct. 20th, 1892, having suffered from a severe pleuropneumonia, the result of a debauch and exposure. He was very sick for three or four weeks expectorating blood and rusty sputa; suffering from high temperature, rapid pulse and respiration; active delirium and progressive adynamia. He had complained constantly of a great deal of pain in the right side, which required the continual effects of morphine to alleviate. The high temperature, rapid pulse and delirium gradually abated, and on the first of December I was asked to examine him with his attending physician, Dr. Brown. The right pleural cavity was found flat on percussion throughout the lower two-thirds of its extent, and there was but little respiratory murmur at the upper part of the right side of the chest.

Over the fourth interspace and about three inches from the sternum it was discovered that air was passing from the lung into the pleural cavity. At least it could be heard distinctly, accompanied by mucous râles. Believing that nature had perforated the visceral pleura and that there was possibly ulceration of the costal pleura going on, we decided to make an opening just below the spot which was deemed by auscultation to be the seat of ulceration. The patient was carefully placed under the influence of chloroform and I made an opening with a bistoury in the lower axillary region, and inserted a drainage tube without resecting any of the rib. This was followed by the discharge of bloody pus

¹ Have since evacuated the pleural cavity of a collection of pus and opened the sinuses.

and sputum and subsequent amelioration of the symptoms. We found that the pus from the pleural cavity was quite thick and thoroughly mixed with blood. He continued to discharge this material by coughing, both through the tube and by the mouth. An examination of the sputum on the 16th of December revealed tubercle bacilli, although none were found in the fluid from the pleural cavity. The drainage tube was left in continuously. He was next treated by chlorine gas diluted with air for a period of six weeks and the cavity washed out by peroxide of hydrogen (1 to 10) on two or three occasions.

The patient suffered from persistent cough and the expectoration of bloody sputum for about three weeks,—although this was not caused by the gas. On account of the flowing of sputum into the general cellular tissue he suffered from a series of sub-cutaneous abscesses, five or six of which were opened; some of these were found to communicate with each other by sinuses. These sinuses were probed from time to time but no necrosed rib was found. The opening from the surface into the lung has now healed up. The man looks well, eats well, and breathes well. He walks about freely—going down town, and coughs very little, excepting in the morning. He takes no stimulant or anodyne. There is still, however, considerable discharge from a fistulous opening in the side of the chest near the point of the incision which has to be dressed twice a day.

This was undoubtedly a case of croupous pneumonia, with empyema, such as Dr. Godlee believes to occur more frequently than is generally recognized.

The man having survived the acute stages, nature evidently set about to make an opening for the pent up material.

By opening up the external parts, inserting a tube, and treating the condition as indicated, art simply assisted the accomplishment of nature's design.

The two cases which I am about to relate both

died, and they were operated upon very much after the manner of Poirier and Jonnesco:

Case 1.—T. S., Canadian by birth, cook by occupation, married, aged 48. Entered Harper hospital Feb. 4th, 1892, suffering from phthisis pulmonalis, presenting the signs of a small excavation in the upper part of the left lung with considerable hepatization throughout that side.

He remained in the hospital until March 8th, during which time he was treated principally by hypodermic injections of iodine and chloride of gold and sodium and inhalations of chlorine gas. At the time of his discharge he was very much improved, the physical signs showing retrogression of the pulmonary disease. He was heard from occasionally after that as improving, and I believe resumed work, but was taken sick the latter part of November with what was supposed to be croupous pneumonia; and was brought to the hospital again in February of 1893. At this time he was very weak, emaciated, with several good sized cavities in the left lung, also one at the right apex. He suffered from marked hectic fever and considerable diarrhœa. He was treated systematically by various things and the disease for a time was held in abeyance. But later on he gradually lost flesh and strength, and was surely approaching the end. On March 15th, having obtained the patient's consent and that of his friends, I opened one of the cavities of the left lung through the second intercostal space in the manner already stated. The cavity sought for seemed to be quite superficial but was found to be at least two inches from the pleural surface, and cutting through the lung tissue even with the galvano-cautery knife, brought on considerable hemorrhage. The hemorrhage soon stopped, however, but after the insertion of the tube the patient seemed to collapse. We thought he would die on the table. However, hypodermic injections of stimulants were administered at once, and he soon rallied and was immediately taken to his bed wrapped up in hot woolen clothing, surrounded by hot bottles, while the hypodermic injections of stimulants—nitro-glycerin and digitalin, etc. were continued at short intervals until he completely reacted which took place in about an hour and a half. He then expressed himself as feeling very comfortable, in fact better than he had for "a long time." He stood the chlorine gas well, and seemed better, but died on the eighth day after the operation, from a sudden and very copious hemorrhage. On the evening of the 15th of March, the day of the operation, the cavity was drained through the tube, and the introduction of chlorine gas commenced in a manner before mentioned. Chlorine gas was used about every four hours, six to twelve bulb-fulls being introduced each time. He never complained of

any pain and very little cough was excited by this procedure. He always expressed himself as feeling very comfortable after it. The cough almost entirely ceased; the cavities being drained out occasionally by turning him over to the right side.

The source of the hemorrhage which was the immediate cause of his death was probably the opening of a good sized pulmonary vessel. Whether this was caused by the mechanical irritation of the end of the tube, or the accidental rupture of some old aneurism can only be conjectured as a post-mortem examination unfortunately could not be obtained.

Case 2.—A. M., German, aged 27; tailor; lived in United States eleven years; both parents died of phthisis pulmonalis. He had suffered from cough for six years which he thought resulted from "a cold." Had had several attacks of hemoptysis with exacerbations of chills and fever on and off during this time. He was admitted to Harper hospital February 13th, very much emaciated and debilitated, scarcely able to be up and around the ward more than three or four hours a day.

For some time before his admission he had had constant high temperature, rapid pulse and a large amount of expectoration.

The physical signs showed a large anfractuous cavity possibly bronchiectatic at the upper left apex, with smaller cavities below this and in the lower portions of the lungs. The respiratory murmur at the former situation was purely tubular, and there was at all times well marked pectoriloquy. This large cavity seemed to be very near the external surface. Repeated examinations of sputum showed no tubercle bacilli.

He was placed for a time on a treatment by hypodermic injections of iodine and inhalations of chlorine gas, but showed no marked improvement, except a diminution of expectoration and pyrexia, so that he was rapidly failing and it was apparent would soon die. Now, as the location of the larger excavations seemed to be very favorable for operation I obtained his consent to do it, and on March 21st cut into the cavity at the left apex, through the third intercostal space in the manner previously detailed.

He took the anæsthetic very well, and the operation occupied but a few minutes. There was no hemorrhage at the time, and he maintained a tolerably good physical condition throughout. A tube was inserted immediately after the operation, and he was removed to his bed. The examination with the finger at the time showed the excavation to be large, tortuous and smoothly lined. This latter indication led us to doubt whether the cavity had really been reached or not, but by swinging the finger around it

was felt to be limited or walled all around, so that, taken together with the fact that the two layers of pleura seemed to be adherent, according to the test given by Poirier, viz: (the ability to see the movement of the lung through the costal layer, and the immobility of the free end of a needle with which the pleural layer was transfixed just previous to the opening) we finally lost all doubt. Dr. H. O. Walker and Dr. P. M. Hickey who kindly assisted me at this time, shared with me the doubt for a time. Moreover the presence, just at the bottom of the excavation, of a good sized pulmonary artery which could be felt by the finger, rendered any further puncturing hazardous. The cavity was drained and treated as in the former case. The patient's cough ceased and for a week he seemed to be improving. But at this time he was taken with diarrhœa which became obstinate, and seemed to reduce his strength very fast. Coincident was this, there was a strong odor of skatol which could be observed at times emanating from the breath. Whether this came directly from the intestinal canal through the esophagus, or whether it resulted from some chemical reaction of the chlorine gas within the lungs, of course could not be determined. I simply mention it as an interesting observation. The diarrhœa continued with more or less violence despite all measures which we could adopt, and he died from exhaustion April 14th.

The temperature during the last week of his life ranged between 101° and $103\frac{1}{2}^{\circ}$. He complained of little or no pain, although after the first two or three days succeeding the operation he had very little morphia. The introduction of chlorine gas seemed to cause no irritation, but always a sense of relief and at no time after the operation did the expectoration amount to very much,—excepting, perhaps the three or four days before his death, when we removed the tube and stopped all except palliative medication. Perhaps if the operation could have been made earlier, this man might have survived a long time.

The foregoing cases, abstracts of which I have given, do not make a very good showing in advocacy of this plan of treatment I admit. But it must be remembered that they were hopeless cases whose courses were nearly run.

I hope to have an opportunity soon of repeating this method of treatment upon cases that are not so far advanced.

While the results of the treatment of the earlier stages of the several forms of phthisis pulmonalis, (exclusive of general tuberculosis) by the plan of

hypodermic injections of iodine and chloride of gold and sodium have been all that could be expected, still in the many cases of advanced excavation and caseation in which all methods of medication seem to fail, it would seem imperative that we should seek new methods of treatment and especially ascertain whether or not surgical procedures will assist nature in staying the progress of this disease in this class of cases.

The particular points which I desire to urge upon your consideration, are, first, those made by Poirier and Jonnesco, viz: to open the cavity freely near the apex *without resecting ribs*, and to use the galvanocautery knife for opening through the lung tissue; and second, the use of chlorine, ozone, bromine or some other antiseptic gas instead of a fluid for the local medication, for the latter it seems obvious can not be well tolerated by even diseased lung tissue outside of the cavity itself. Whereas with the use of a *gas* which is tolerable and capable of diffusion, we may hope to reach remotely diseased portions of lung which are in process of breaking down as well as to render the caseous material in and about the excavation more or less incapable of producing further infection. Another point to which I desire to call your attention before closing is the question of adhesion between the two pleural layers. It is plain that if the costal and visceral layers are not adherent, it is inadvisable to proceed further with the incision. Now whether the directions promulgated by Poirier and Jonnesco are infallible guides in all cases remains to be seen. However, I think that in the majority of instances all doubt will be dispelled by the insertion of a clean needle and the observation as to the mobility of its free end. I am not here to advocate surgical measures which would prove fatal in all cases, but I trust that the untoward events which I have here presented may lead some possessed of more surgical aptitude to initiate and perfect a better plan for the relief of these universally fatal cases.

